Original Article

Bier's block using lignocaine and butorphanol

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Abstract

Background: Opioids are most commonly used as adjuncts in intravenous regional anesthesia (IVRA) to improve the quality of intraoperative and postoperative analgesia. There is paucity of literature on the use of butorphanol in IVRA.
Aims: The aim of this study was to evaluate the likely benefits of addition of butorphanol to lignocaine in Bier's block in terms of onset and duration of sensory block and also for analgesic requirement in postoperative period.
Settings and Design: A randomized double blind study was conducted at Tertiary Care Educational Institute.
Patients and Methods: A total of 40 adult ASA I or II patients scheduled to undergo upper limb surgery were randomized in two groups (n=20). Group I received 3 mg/kg of lignocaine alone and group II received 1 mg butorphanol in addition to 3 mg/kg lignocaine. Sensory block onset time and time to recovery from sensory block after tourniquet deflation were noted using the pin prick method. Duration of postoperative analgesia was noted using a visual analogue scale. All the patients were compared for the time to first rescue analgesic consumption and total analgesic consumption in first 24 hours postoperatively.
Statistical Analysis Used: The statistical analysis was done using unpaired Student's t-test.
Results: Our study showed significant prolongation of postoperative analgesia in group II as noted by the time to first analgesic requirement. Total analgesic consumption in first 24 hours postoperatively was less in group II. Sensory block onset time and time to recovery from sensory block after tourniquet deflation, did not show any significant difference between the two groups.
Conclusions: Addition of butorphanol to lignocaine in IVRA significantly prolongs the duration of postoperative analgesia and 24 hours analgesic consumption is less in patients receiving butorphanol along with lignocaine in IVRA. However, there is no effect on sensory block onset time and time to recovery from sensory block.

Key words: Bier's block, butorphanol, intravenous regional analgesia, intravenous regional anesthesia, lignocaine

Introduction

Regional anesthesia holds an important place in developing countries because of its simplicity, safety, and economy. For anesthesia of hand and forearm, intravenous regional anesthesia (IVRA), also called Bier's block, was first described by German surgeon August Bier in 1908.[1] The earliest agent used was procaine, but the technique soon fell into disrepute because of the cumbersome technique and adverse effects of procaine. This technique was largely forgotten until 1983, when Holmes used lignocaine instead of procaine in IVRA.[2] IVRA has since then evolved as a safe, reliable, and cost-effective technique for providing anesthesia as well as bloodless field during upper limb surgery.[3,4] It has been postulated that the site of action in IVRA is probably by blockade of small nerves or possibly nerve endings and not the major nerve trunks.[5,6]

The ideal IVRA solution should have rapid onset, require less dose of local anesthetic (LA), reduce tourniquet pain, and prolong post-deflation analgesia. This may be achieved by addition of adjuncts to LA. Anesthesiologists have been striving for many years to improve the efficacy and duration of regional anesthesia by injecting opioids close to nerve trunks or nerve endings. Opioids are most commonly used as adjuncts in IVRA along with local anesthetics.[7] The peripheral action of opioids could theoretically be mediated via a peripheral opioid receptor or by their own local anesthetic action.[8,9] Clinical evidence for the efficacy of peripherally administered opioids is mixed.

There is paucity of literature on the use of opioids, especially butorphanol, in IVRA. We combined butorphanol tartrate,

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a synthetic opiate, with lignocaine hydrochloride in IVRA for upper limb surgery and compared it with IVRA using lignocaine only. We evaluated the likely benefits of addition of butorphanol to lignocaine in Bier's block in terms of onset and duration of sensory block and also for analgesic requirement in postoperative period.

Patients and Methods

After obtaining approval from hospital ethical committee, 40 adult ASA I or II patients scheduled for surgery on hand or forearm, were randomized into two groups (n=20) by computer-generated random number allocation. Informed written consent was taken from all patients. Both the patients and the researchers were blinded to the type of injectate used, i.e., injectate with or without butorphanol. In group I, 20 patients received 3 mg/kg of lignocaine diluted with normal saline to a total volume of 40 ml, while in group II, 20 patients received 3 mg/kg of lignocaine, and 1 mg butorphanol diluted with normal saline to a total volume of 40 ml. Uncooperative patients and patients who refused to enter the study, patients with Raynaud's disease, sickle cell disease, non-fasting patients, and in whom surgery lasted more than 60 minutes were excluded from the study.

A thorough pre-anesthetic evaluation was done prior to surgery. The baseline pin prick score was analyzed by using a 25G sterile needle at forearm or hand with intact skin on a three-point scale (2 = normal sensation, 1= blunted sensation, and 0= absence of sensation). The 11-point 100 mm visual analog scale (VAS) was shown to all patients on pre-anesthetic check-up, and they were made familiar with it.

No premedication was given to the patients. Monitoring of heart rate, non-invasive blood pressure, respiratory rate, electrocardiogram (ECG), and peripheral oxygen saturation (SpO_2) was continued throughout the procedure. The standard double-tourniquet technique of IVRA was used in all the patients. The patients were assessed for onset of sensory block using a pin prick method using a 25G sterile needle at forearm or hand on intact skin every 30 seconds from the time of injecting drugs till the pin prick score was 0 and it was taken as the sensory block onset time. The distal tourniquet was observed continuously for unintentional slow deflation. The distal tourniquet remained inflated for a minimum of 20 minutes and maximum of 60 minutes from the time of injection of the solution.

Recovery from sensory block was assessed by the pin prick method every 2 minutes after tourniquet release, till the pin prick score returned to the baseline value. This time interval was taken as the sensory block recovery time. After tourniquet deflation, the patients were monitored for 24 hours for pain assessment. Whenever the patient complained of pain, its intensity was evaluated using VAS. Rescue analgesic in the form of diclofenac sodium 75 mg IM was given to the patients if VAS was more than 4 and time to first analgesic (TTFA) was noted. Total analgesic consumption in 24 hours was calculated. Patients were also observed for any side effects to the drugs used.

The data obtained were analyzed statistically using unpaired Student's t-test and $P>0.05$ was considered statistically significant.

Results

The demographic data including age, sex, and body weight were comparable in both the groups. The groups were also comparable for the total duration of surgery, type of surgery, and the amount of lignocaine used [Table 1]. There was no statistically significant difference in baseline hemodynamic parameters and mean SpO_2. Patients in both the groups remained hemodynamically stable throughout the observation period and the variations so noted were statistically insignificant [Figures 1-3].

No significant enhancement in sensory block onset time was observed after addition of butorphanol to lignocaine in group II. Addition of butorphanol to lignocaine in group

Table 1: Demographic profile

Group	Group I (n=20)	Group II (n=20)
Age (years)	39.5±15.81	44.3±13.5
Sex (M:F)	10:10	15:5
Weight (kg)	72.75±8.58	75.4±8.47
Duration of surgery (min)	29.75±11.53	29.05±14.32
Amount of lignocaine (mg)	217.3±27.83	224.1±27.08
Type of surgery [no. of patients (%)]		
Carpal tunnel release	7 (35)	5 (25)
Forearm plating/removal	5 (25)	6 (30)
Ganglion excision	2 (10)	4 (20)
K-wire insertion/removal	3 (15)	3 (15)
Close reduction	3 (15)	2 (10)

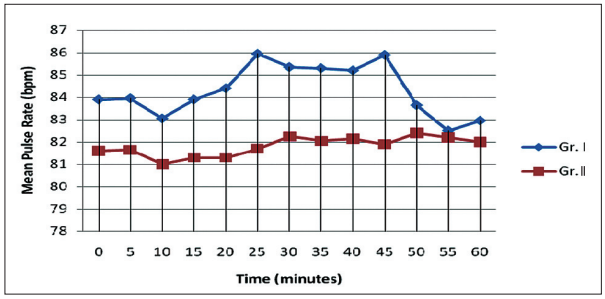

Figure 1: Trends in the pulse rate among subjects of the two groups

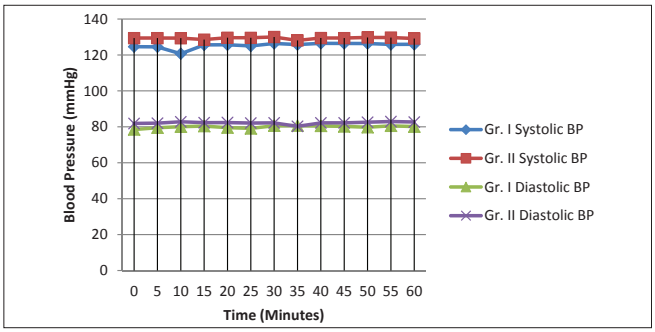

Figure 2: Trends in systolic and diastolic blood pressure

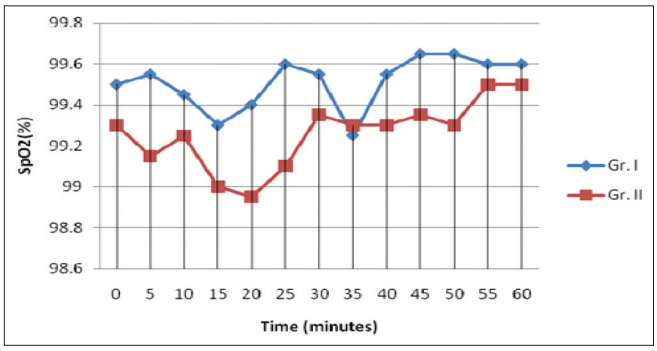

Figure 3: Trends in oxygen saturation among subjects of the two groups

II also did not significantly alter the duration of recovery time from sensory block after the deflation of the tourniquet [Table 2]. All the patients were also observed for the duration they remained pain free postoperatively. This was noted as time to first analgesic consumption (TTFA). TTFA was significantly prolonged (*P* value<0.05) in group II. The total number of rescue analgesic injections (Diclofenac sodium 75 mg IM) in the postoperative period was also found to be significantly less in patients who received butorphanol in IVRA [Table 2]. We did not encounter any serious side effect of any of the drugs used [Table 3].

Table 2: Block characteristics

Sensory block (minutes)	Group I	Group II	*P* value
Onset of sensory block	5.05 ± 2.10	3.88 ± 2.34	0.099148
Recovery from sensory block after tourniquet deflation	13.60 ± 5.40	17.20 ± 6.72	0.088352
Time to first analgesic	73.63 ± 61.32	169.50 ± 99.25	0.007020
Number of rescue injections (doses)	2.37 ± 0.83	1.65 ± 0.88	0.009693

Values are given as mean ± SD

Table 3: Side effects

Side effects	Group-I		Group-II		*P* value
	No.	% age	No.	% age	
Hypotension	1	5.00	1	5.00	-
Tinnitus	1	5.00	0	0.00	0.317308
Perioral tingling	2	10.00	1	5.00	0.049746
Nausea	0	0.00	1	5.00	0.317308

Discussion

In the era of day care surgery, rapid induction, recovery time, and minimal hospital stay, intravenous regional anesthesia is a useful, reliable, and cost-effective method of anesthesia.[10,11] It provides adequate relaxation when used for upper limb surgery.[12] It is also a popular choice in trauma and emergency services as a large number of cases are those of fracture and limb injuries resulting from road traffic accidents and intravenous regional anesthesia would be a useful technique in those patients who are ill prepared for general anesthesia.

The relief of pain during surgery is the aim of anesthesia and the expertise required in this field can be extended into the postoperative period to provide postoperative analgesia. Painful stimuli produced by a surgical incision, can lead to a hyper-excitable state in the spinal cord, which can exacerbate the postoperative pain.[13] Once this state has been established, a larger dose of analgesic is usually required. If drugs are administered before the painful stimulus, postoperative pain can be greatly diminished.[14] Various drugs and techniques of their administration have shown varying degree of success. Intravenous, intramuscular, or epidural opioids have been shown to reduce the severity of the postoperative pain to a greater extent when administered before surgical stimuli rather than following it.

Opioids have long been used as adjuvants in IVRA, though their mode of action remains unclear. Fentanyl has been used in the dose range of 50-200 µg.[15] Reuben *et al.* studied the effects of adding 10-50 mg meperidine as adjunct to 0.5% lignocaine in IVRA.[16] The duration of analgesia increased in a dose-dependent manner in patients receiving 10, 20, 30 mg of meperidine. Siddiqui *et al.* used tramadol as an adjuvant to intravenous regional anesthesia with lignocaine.[17] Patients receiving tramadol had longer time to first postoperative analgesic request. Ramaiah *et al.* used butorphanol and parexocib as adjuncts to lignocaine in IVRA and found significant prolongation of postoperative analgesia in the butorphanol used group.[18] Kaya *et al.* showed significant reductions in the amplitude of nerve conduction velocities with meperidine.[19]

We used butorphanol tartrate 1 mg as an adjuvant to lignocaine (3 mg/kg body weight) in IVRA for upper limb surgery and compared it with the control group, where no adjuvant was added to lignocaine. We studied the effects of addition of butorphanol to lignocaine in IVRA on onset and recovery

from sensory block and on postoperative analgesic requirement.

We used 3 mg/kg of 2% lignocaine diluted with normal saline to make a total solution of 40 ml which was similar to that used by Harris, 1965[20] Reuben, 2002,[4] and Turan, 2005.[21] 1 mg butorphanol was added to 3 mg/kg of lignocaine diluted with normal saline to make a total solution of 40 ml. A dose of 1 mg butorphanol was preferred, as it is known to produce significant analgesia with minimal side effects.[22] Galloway *et al*. studied the analgesic properties of different doses of intravenous butorphanol (0.5 mg, 1 mg, and 2 mg) and meperidine (20 mg and 40 mg) and their side effects. The 1 mg dose of butorphanol produced analgesia for 2-4 hours duration with minimal postoperative sedation or other side effects, whereas 2 mg dose was associated with excessive postoperative sedation.

The time to onset of sensory block was 5.05±2.10 minutes in group I compared to 3.88±2.34 minutes in group II which was statistically comparable (*P* value 0.099) implying that there was no significant change in the onset of sensory block after the addition of butorphanol in group II. Ware compared bupivacaine with lignocaine for conventional IVRA.[23] The mean injection to analgesia time for the lignocaine group in his study was 4.5±0.3 minutes which were similar to that in our study.

The time to recovery from sensory block after tourniquet deflation was 13.60±5.40 minutes in group I compared to 17.20±6.72 in group II. This difference was statistically not significant (*P* value 0.088). The use of butorphanol as an adjunct to lignocaine did not provide any additional benefit in terms of onset of and recovery from sensory block in IVRA. There is paucity of literature on the use of butorphanol in IVRA and despite an extensive search of literature, we could not find any reference on time to recovery from sensory block in IVRA.

In our study, when the patient complained of pain postoperatively and if VAS was found to be ≥4, analgesia with injection 75 mg diclofenac sodium IM was given. The mean time to first rescue analgesic requirement in the lignocaine group was 73.63±61.32 minutes. Turan *et al*. reported similar results with the time to first postoperative analgesic requirement with lignocaine as 95±29 minutes.[21] In the butorphanol group time to first rescue analgesic was administered at 169.50±99.25 minutes. The possible reason behind longer time to first rescue analgesic can be the systemic absorption of butorphanol after release of the tourniquet, which acted upon opioid receptors in the central nervous system.

Mean total rescue analgesic injection consumption in the first 24 hours was 2.37±0.83 injections per subject in group I and 1.65±0.88 injections per subject in group II. The results were statistically significant (*P* value 0.01). A significantly lesser number of postoperative rescue analgesic injections (diclofenac sodium 75 mg IM) were required in group II, an obvious advantage for the patient, in terms of cost and rescue analgesic drug-related side effects. Side effects and complications due to the drugs used in both groups were not serious in nature and were managed conservatively.

We conclude that addition of 1 mg butorphanol tartrate to lignocaine in IVRA prolongs the time to request for first rescue analgesic and lessens the 24 hour total postoperative analgesic requirement. We recommend the use of butorphanol 1 mg as an adjunct to lignocaine in IVRA as it provides better postoperative analgesia, reduces requirement of postoperative rescue analgesics, and has a good safety profile.

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